# Syllabus – PHYS 343 – Fall 2017

**Course Information:**

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| PHYS 343: | Classical Physics III: Vibration and Waves, 4 credits, Fall 2017 |
| Meeting Times: | MWF, 11:45-12:45; Thurs, 9:30-10:30 |
| Meeting Location: | Reichardt 204 |

**Instructor Information:**


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| Instructor: | Peter Delamere, Professor of Space Physics |
| Office: | 708E Elvey (Geophysical Institute) |
| Email: | Peter.Delamere@gi.alaska.edu |
| Phone: | (907) 474-6442 |
| Office Hours: | Tues: 1:00 to 4:00 (Reichardt) or By appointment (Elvey) |


**Prerequisites:** Physics 342

**Scope:** This final course in the Classical Physics sequence addresses normal modes and small vibrations, continuum systems, wave mechanics, electromagnetic waves and radiation, relativistic mechanics and electromagnetism.

**Approach:** The course is intended to address all aspects of wave phenomena in Classical Physics. We will start with simple coupled oscillations and normal mode analysis. The secret of normal mode analysis is to identify a coordinate system where each component oscillates with a single, well-defined frequency. That is, no coupling occurs among the normal coordinates. And at the root of the normal mode problem is eigenmode analysis. Students will become quite familiar with eigenfrequencies, eigenvectors and orthogonality. The second topic addresses vibrating strings, or continuous systems from which we will derive the wave equation. Wave mode analysis is at the core of many branches of physics. We will address solutions to the wave equation and such fundamental wave concepts as phase and group velocity, dispersion, attenuation, wave packets, spectral distribution, beats, modulation, reflection, transmission, and polarization. The third topic will be involve electromagnetic waves and radiation (basically a continuation of PHYS 342). Finally, the course will culminate with the special theory of relativity, relativistic mechanics, and relativistic electrodynamics.

**Topics:**

- Coupled oscillations and normal mode analysis (eigenmode analysis)
- Continuous systems and the wave equation
- Basic wave concepts
- Electromagnetic waves and radiation
- Special theory of relativity
- Relativistic mechanics
- Relativistic electrodynamics

**Student learning outcomes:** Upon completion of this course, students should be able to:

- Conduct normal mode analysis and feel very comfortable with the eigenmode problem.
- Systematically develop properties of continuous systems (e.g., vibrating strings) and derive the wave equation.
- Solve the wave equation.

- Connect wave concepts to the broad range of topics in physics that involve waves, e.g., water, sound, electromagnetic, seismic, and plasma waves.
- Derive the wave equation for electric and magnetic fields.
- Utilize Liénard-Wiechert potentials.
- Understand the origin of electromagnetic radiation.
- Appreciate the origins and development of the special theory of relativity.

**Textbook:**
Griffiths, D. J., Introduction to Electrodynamics, Third Edition.
Taylor, John R., Classical Mechanics.

**Programming languages:** Should numerical solutions be requested, students are welcome to submit programming solutions in the language of their choice. Recommended languages for this course are Matlab, IDL, and Python.

**Grading:**

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| Homework | 30% |
| Midterm #1 | 20% |
| Midterm #2 | 20% |
| Final Exam | 30% |

**Course Policies:**

(a) Attendance and participation in class is expected of all students.
(b) Assignments are due at the beginning of class on the due date.
(c) Students are encouraged to work together on homework problems, but the final written solutions must be individual work.
(d) Students must acknowledge all sources of information – included fellow students – used in homework solutions and final projects. The UAF catalog states: "The university may initiate disciplinary action and impose disciplinary sanctions against any student or student organization found responsible for committing, attempting to commit or intentionally assisting in the commission of . . . cheating, plagiarism, or other forms of academic dishonesty. . . "
(e) All UA student academics and regulations are adhered to in this course. You may find these in the UAF catalog (section "Academics and Regulations").

**Students with Disabilities Notice:** The University of Alaska Fairbanks is committed to equal opportunity for students with disabilities. Students with disabilities are encouraged to contact the coordinator of Disability Services (Mary Matthews) at the Center for health & Counseling (x7043). See section on Disability Services of the UAF Class Schedule (http://www.uaf.edu/schedule/).

**Schedule:**

| Topic | Week | Dates |
|---|---|---|
| E&M conservation laws | 1 | |
| Coupled oscillations and continuous systems | 2-5 | |
| ***Midterm #1*** | 5 | Friday, September 29 |
| General wave properties and electromagnetic waves | 6-10 | |
| ***Midterm #2*** | 10 | Friday, November 3 |
| Electromagnetic radiation and relativity | 11-15 | |
| ***Final exam*** | 16 | 10:15 a.m.-12:15 p.m., Fri., Dec. 15 |